IEEE CONTROL SYSTEMS SOCIETY
TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... September 2019

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1. Editorial

Welcome to the 2019 September issue of the newsletter,
also available electronically at
http://discrete-event-systems.ieeecss.org/tc-discrete/newsletters

You are welcome to submit new items to the newsletter (topics including schools,
workshops, sessions, conferences, journals, books, software, positions).
To submit a new item, please use the following website:
https://www.control.eng.osaka-cu.ac.jp/miscellaneous/css-tc-des/submission
or email to kai.cai@eng.osaka-cu.ac.jp.

To subscribe, please email to kai.cai@eng.osaka-cu.ac.jp.
To unsubscribe, please reply to this email with the subject line UNSUBSCRIBE.

2. Invited Sessions and Workshops

2.1 Call for contributions: Invited Session at 2020 American Control Conference

Dr. Xiang Yin and Dr. Kai Cai are planning to organize an invited session on "Safety, Fault-Tolerance, Security of Networked Discrete-Event Systems" at ACC'20, to be held in Denver, CO, USA, July 1-3, 2020 (http://acc2020.a2c2.org). The objective of this invited session is to present recently developed novel approaches devoted to the large-scale networked control systems using DES models. This session will be sponsored by IEEE CSS TC on Discrete Event Systems.

If you are interested, please contact Dr. Xiang Yin (yinxiang@sjtu.edu.cn) by Sep. 16, 2019 (Mon).
The paper submission deadline is (currently) Sep. 23, 2019.

2.2 Call for contributions: 2020 Workshop on Discrete Event Systems

The interdisciplinary field of Discrete Event Systems (DES) combines different formalisms, methodologies and tools from control, computer science and operations research. The research activity in this field is driven by the needs of many different applications domains: manufacturing, process control, supervisory systems, software engineering, transportation, etc.

The 15th Workshop on Discrete Event Systems aims at providing researchers from different fields (control theoreticians and control engineers, software engineers and computer scientists, operations research specialists) with an opportunity to exchange information and new ideas, and to discuss new developments in the field of DES theory and applications.
The workshop will cover all topics in DES theory and applications, including (but not limited to) the following:
- Formalisms and modeling methodologies: Petri nets, automata, state charts, process algebras, max-plus algebra, queueing networks;
- Control of discrete-event systems with emphasis on supervisory control and on real time control;
- Performance evaluation, optimization and scheduling;
- Diagnosis, fault detection, test, identification;
- Discrete approaches for hybrid systems;
- Event-driven methods in systems and control;
- Applications including manufacturing systems, transportation systems, power production, distributed systems,
  software engineering, home automation, workflow, telecommunication systems, biological systems;
- Automation methods and software tools enabling efficient handling of industrial-sized systems.

WODES 2020 will be held at Military Institute of Engineering (IME), which, together with Polytechnic School of the Federal Universtiy of Rio de Janeiro, is the oldest engineering school of all Americas. It is located at the pleasant neighborhood of Urca, opposite to Praia Vermelha (Red Beach) and next to the Cable Station to Sugar Loaf. It stays a few minutes away from the famous beaches of Copacabana, Ipanema and Leblon.

Important Dates
- Special Session Proposals Due: October, 31st 2019
- Submission Site Opens: November, 10th 2019
- Initial Paper Submission Due: December, 16th 2019
- Decision Notification: February, 17th 2020
- Registration Site Opens: February, 24th 2020
- Final Submissions Due: March, 9th 2020

3. Selections of Journal Publications

Contributed by: Xiang Yin (yinxiang@sjtu.edu.cn)

3.1. Selections of Automatica
VOLUME: 107, September 2019

(1) On Max-plus linear dynamical system theory: The observation problem

Authors: Vinicius Mariano Gonalves ; Carlos Andrey Maia ; Laurent Hardouin

Abstract: In this paper, we are interested in the general problem of estimating a linear function of the states for a given Max-Plus linear dynamical system. More precisely, using only the current and past inputs/outputs of the system, we want to construct a sequence that converges in a finite number of steps to the value given by a linear function of the states, for all initial conditions of the system. We provide necessary and sufficient conditions to solve this general problem. We also define and study a Max-Plus version of the well-known Luenberger observer, which is a subclass of the general problem that we are interested in, and we also provide necessary and sufficient conditions to solve this particular problem of observer synthesis. Finally, we show that there are important connections between results in the Max-Plus domain and associated results in the standard linear systems theory.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109819302420

(2) Compositional construction of infinite abstractions for networks of stochastic control systems

Authors: Abolfazl Lavaei ; Sadegh Soudjani ; Majid Zamani

Abstract: This paper is concerned with a compositional approach for constructing infinite abstractions of interconnected discrete-time stochastic control systems. The proposed approach uses the interconnection matrix and joint dissipativity-type properties of subsystems and their abstractions described by new notions of so-called stochastic storage functions. The interconnected abstraction framework is based on new notions of so-called stochastic simulation functions, constructed compositionally using stochastic storage functions of components. Using stochastic simulation functions, one can quantify the distance between original interconnected stochastic systems and interconnected abstractions in the probabilistic setting. Accordingly, one can leverage the proposed results to perform analysis and synthesis over abstract interconnected systems, and then carry the results back over concrete ones. In the first part of the paper, we derive dissipativity-type compositional reasoning for the quantification of the distance in probability between the interconnection of stochastic control subsystems and that of their abstractions. Moreover, we focus on a class of discrete-time nonlinear stochastic control systems with independent noises in the abstract and concrete subsystems, and propose a computational scheme to construct abstractions together with their

corresponding stochastic storage functions. In the second part of the paper, we consider specifications expressed as syntactically co-safe linear temporal logic formulae and show how a synthesized policy for the abstract system can be refined to a policy for the original system while providing a guarantee on the probability of satisfaction. We demonstrate the effectiveness of the proposed results by constructing an abstraction (totally 3 dimensions) of the interconnection of three discrete-time nonlinear stochastic control subsystems (together 222 dimensions) in a compositional fashion such that the compositionality condition does not require any constraint on the number or gains of the subsystems. We also employ the constructed abstraction as a substitute to synthesize a controller enforcing a syntactically co-safe linear temporal logic specification.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109819302626

(3) Compositional synthesis of finite abstractions for networks of systems: A small-gain approach

Authors: Abdalla Swikir ; Majid Zamani

Abstract: In this paper, we introduce a compositional scheme for the construction of finite abstractions (a.k.a. symbolic models) of interconnected discrete-time control systems. The compositional scheme is based on small-gain type reasoning. In particular, we use a notion of so-called alternating simulation functions as a relation between each subsystem and its symbolic model. Assuming some small-gain type conditions, we construct compositionally an overall alternating simulation function as a relation between an interconnection of symbolic models and that of original control subsystems. In such compositionality reasoning, the gains associated with the alternating simulation functions of the subsystems satisfy a certain °∞small-gain°± condition. In addition, we introduce a technique to construct symbolic models together with their corresponding alternating simulation functions for discrete-time control subsystems under some stability property. Finally, we apply our results to the temperature regulation in a circular building by constructing compositionally a finite abstraction of a network containing rooms for any . We use the constructed symbolic models as substitutes to synthesize controllers compositionally maintaining room temperatures in a comfort zone. We choose for the sake of illustrating the results. We also apply our proposed techniques to a nonlinear example of a fully connected network in which the compositionality condition still holds for any number of components. In these case studies, we show the effectiveness of the proposed results in comparison with the existing compositionality technique in the literature using a dissipativity-type reasoning.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109819303176

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3.2. Selections of the IEEE Transactions on Automatic Control
VOLUME: 64, ISSUE: 9, September 2019

(1) State Classification and Multiclass Optimization of Continuous-Time and Continuous-State Markov Processes

Authors: Xi-Ren Cao

Abstract: We address the long-standing problem of state classification and multiclass optimization of the time-nonhomogeneous continuous-time and continuous-state Markov processes (CTCSMPs). The fundamental property required for state classification is weak ergodicity, with which the state space can be grouped into multiple classes of weak ergodic and branching states. The fundamental property for performance optimization is the state comparability. Optimality conditions are derived for long-run average problems for multiclass CTCSMPs; they take the same form as those for discrete-state Markov processes. It is shown that a stochastic diffusion process is separated by degenerate points into multiple classes. The results also cover the underselectivity issue for long-run average and optimization with nonsmooth value functions. The problem is solved by the relative optimization approach that has been successfully applied to many optimization problems that are not very amenable to dynamic programming.

Full-text available at: https://ieeexplore.ieee.org/document/8668800

(2) A Principled Approximation Framework for Optimal Control of Semi-Markov Jump Linear Systems

Authors: Saeid Jafari ; Ketan Savla

Abstract: We consider continuous-time, finite-horizon, optimal quadratic control of semi-Markov jump linear systems (S-MJLS), and develop principled approximations through Markov-like representations for the holding-time distributions. We adopt a phase-type approximation for holding-time distributions, which is known to be consistent, and translates an S-MJLS into a specific MJLS with partially observable modes (MJLSPOM), where the modes in a cluster have the same dynamic, the same cost weighting matrices, and the same control policy. For a general MJLSPOM, we give necessary and sufficient conditions for optimal (switched) linear controllers. When specialized to our particular MJLSPOM, we additionally establish the existence of an optimal linear controller, as well as its optimality within the class of general controllers satisfying standard smoothness conditions. The known equivalence between phase-type distributions and positive linear systems allows us to leverage existing modeling tools, but possibly with large computational costs. Motivated by this, we propose a matrix-exponential approximation of holding-time distributions, resulting in pseudo - MJLSPOM representation, wherein the transition rates could be negative. Such a representation is of relatively low order, and

maintains the same optimality conditions as for the MJLSPOM representation, but could violate nonnegativity of holding-time density functions. A two-step procedure consisting of a local pulling-up modification and a filtering technique is constructed to enforce nonnegativity.

Full-text available at: https://ieeexplore.ieee.org/document/8528323

(3) Stochastic Filtering of Max-Plus Linear Systems With Bounded Disturbances

Authors:Rafael Santos Mendes ; Laurent Hardouin ; Mehdi Lhommeau

Abstract: The objective of this paper is to propose a filtering strategy for max-plus linear systems with bounded disturbances without the direct calculation of the a posteriori state probability. The strategy is based on the inversion of the expectation of the measure with respect to the state variable. Among the possible solutions, the closest to the prediction is chosen. An algorithm, based on interval propagation, is proposed to solve this problem. Simulations are performed to show the consistence of the proposed methodology with other approaches in the literature.

Full-text available at: https://ieeexplore.ieee.org/document/8579578

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3.3. Selections of the IEEE Transactions on Control Systems Technology
VOLUME: 27, ISSUE: 5, September 2019

(1) Design of a Hybrid Controller for Pressure Swing Adsorption Processes

Authors: Mohammad Fakhroleslam ; Ramin Bozorgmehry Boozarjomehry ; Shohreh Fatemi ; Elena De Santis ; Maria Domenica Di Benedetto ; Giordano Pola

Abstract: The aim of this paper is to synthesize a hybrid controller for pressure swing adsorption (PSA) processes. Since the process is described by a set of partial differential algebraic equations, first a local reduced-order model (LROM) for the process is developed and is formalized as a hybrid system. A hybrid controller is designed for purity control of the process in the presence of external disturbances by determining the maximal safe set of the LROM. A hybrid backward reachability analysis is performed for this purpose. Considering a realistic scenario for PSA processes where the states are not available and the number of measurement sensors is very limited, the desired states are estimated by using a hybrid observer. The controller is designed and applied to a two-bed, six-step PSA process whose dynamical behavior is simulated by a full-order principle-based model of the process. An excellent performance of the controller is obtained.

Full-text available at: https://ieeexplore.ieee.org/document/8392789
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3.4. Selections of the IEEE Control Systems Letters
VOLUME: 3, ISSUE: 4, October 2019

(1) Active Perception and Control From Temporal Logic Specifications

Author: Rafael Rodrigues da Silva ; Vince Kurtz ; Hai Lin

Abstract: Next-generation autonomous systems must execute complex tasks in uncertain environments. Active perception, where an autonomous agent selects actions to increase knowledge about the environment, has gained traction in recent years for motion planning under uncertainty. One prominent approach is planning in the belief space. However, most belief-space planning starts with a known reward function, which can be difficult to specify for complex tasks. On the other hand, symbolic control methods automatically synthesize controllers to achieve logical specifications, but often do not deal well with uncertainty. In this letter, we propose a framework for scalable task and motion planning in uncertain environments that combines the best of belief-space planning and symbolic control. Specifically, we provide a counterexample-guided-inductive-synthesis algorithm for probabilistic temporal logic over reals (PRTL) specifications in the belief space. Our method automatically generates actions that improve confidence in a belief when necessary, thus using active perception to satisfy PRTL specifications.

Full-text available at: https://ieeexplore.ieee.org/document/8728140

(2) Compositional Synthesis of Symbolic Models for Networks of Switched Systems

Author: Abdalla Swikir ; Majid Zamani

Abstract: In this letter, we provide a compositional methodology for constructing symbolic models for networks of discrete-time switched systems. We first define a notion of so-called augmented-storage functions to relate switched subsystems and their symbolic models. Then we show that if some dissipativity type conditions are satisfied, one can establish a notion of so-called alternating simulation function as a relation between a network of symbolic models and that of switched subsystems. The alternating simulation function provides an upper bound for the mismatch between the output behavior of the interconnection of switched subsystems and that of their symbolic models. Moreover, we provide an approach to construct symbolic models for discrete-time switched subsystems under some assumptions ensuring incremental passivity of each mode of switched subsystems. Finally, we illustrate the effectiveness of our results through two examples.

Full-text available at: https://ieeexplore.ieee.org/document/8728138

(3) A Symbolic Approach to the Self-Triggered Design for Networked Control Systems

Author: Kazumune Hashimoto ; Adnane Saoud ; Masako Kishida ; Toshimitsu Ushio ; Dimos V. Dimarogonas

Abstract: In this letter, we investigate novel self-triggered controllers for nonlinear control systems with reachability and safety specifications. To synthesize the self-triggered controller, we leverage the notion of symbolic models, or abstractions, which represent abstracted expressions of control systems. The symbolic models will be constructed through the concepts of approximate alternating simulation relations, based on which, and by employing a reachability game, the self-triggered controller is synthesized. We illustrate the effectiveness of the proposed approach through numerical simulations.mental passivity of each mode of switched subsystems. Finally, we illustrate the effectiveness of our results through two examples.

Full-text available at: https://ieeexplore.ieee.org/document/8733077

4. Call For Papers

4.1 Journal of Discrete Event Dynamic Systems: Theory and Applications---Topical Collection on Smart Cities

Smart cities have attracted more and more attention in recent years due to the close relationship to sustainable development and to the daily lives of citizens in developed as well as developing countries. The research focus in smart cities involves but is not limited to buildings, transportation, mobility, water system management, security, and pollution control. In order to make cities smarter, a technological infrastructure is required to connect networks of sensors and actuators embedded throughout the urban terrain, and to interact with wireless mobile devices. Smart city is also a great example for cyber-physical systems and the Internet of Things and is a rich domain for research and education.

In this special topical collection on smart cities, we focus on the application of theories and models of discrete event dynamic systems in the general field of smart cities. Papers in the following directions are especially encouraged for submission: Smart Buildings, Intelligent Transportation Systems, Smart Grids, Water System Management, Cyber-security.

Important Dates
- Jan. 1, 2019, announcement of call-for-papers;

- Oct. 1, 2019, paper submission deadline;
- Feb. 1, 2020, expected completion of first round of review;
- Apr. 1, 2020, submission of revised papers;
- Jul. 1, 2020, completion of review process;
- Sept. 1, 2020, accepted papers start appearing Online First.

Guest Editors

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Paper Submission
Submissions should be made through the journal website (https://www.editorialmanager.com/disc/default.aspx), under the TC: Smart Cities category. Contributors are strongly encouraged to read Instructions at
https://www.springer.com/mathematics/applications/journal/10626?detailsPage=pltci_2530565
while preparing their manuscript. Both short papers (less than 12 pages) and regular papers are welcome.

5. Conferences

5.1 57th Annual Allerton Conference on Communication, Control, and Computing
Allerton Park, United States, Sep 24 - Sep 27, 2019

5.2 2019 Conference on Decision and Control
Nice, France, December 11-13, 2019
https://cdc2019.ieeecss.org/

5.3 2020 Workshop on Discrete Event Systems
Rio de Janeiro, Brazil, May 13-15, 2020
https://wodes2020.eventos.ufrj.br

5.4 2020 American Control Conference
Denver, Colorado, USA, July 1-3, 2020
http://acc2020.a2c2.org

5.5 2020 IFAC World Congress
Berlin, Germany, July 12-17, 2020
https://www.ifac2020.org

6. Recruitment

6.1 Assistant Professor/Associate Professor in Systems Engineering at CFINS, Tsinghua University

The center for intelligent and networked systems (CFINS) at Tsinghua University (Beijing, China) (http://www.cfins.au.tsinghua.edu.cn/en/about/index.php) invites applications for one tenure-track position in systems engineering, starting from 2020. The applicant is expected to have a PhD degree in Control Science and Engineering, or Industrial Engineering, or Computer Science or related fields. Candidate will be considered at the assistant and associate professor level. The recruitment process starts now and continue until successful candidate has been identified. Interested applicants please contact Qing-Shan Jia at jiaqs@tsinghua.edu.cn for more details.

About CFINS:

The Center for Intelligent and Networked Systems (CFINS) is to provide a physical and intellectual environment for the intelligent analysis, design, operation and monitoring of complex and networked systems such as computer and communication networks, building systems, power systems, and supply chains by making innovative use of analytical and simulation methods and information technology. Please visit http://cfins.au.tsinghua.edu.cn/en/about/index.php for details.

6.2 PhD position in Control and Optimization of Cyber Physical Systems at CFINS, Tsinghua University

The center for intelligent and networked systems (CFINS) at Tsinghua University (Beijing, China) (http://www.cfins.au.tsinghua.edu.cn) invites applications for PhD positions in the field of control and optimization of energy Internet and smart buildings. Potential applicants with knowledge on Markov decision process, power systems, robotic systems, and/or building systems are especially encouraged to apply. The potential applicant should be expected to receive a Bachelor/MS degree in EE/CS/IE or related areas,
or already have a Bachelor/MS degree in these fields. Applications will be reviewed immediately. Interested applicants, please send an email to (Samuel) Qing-Shan Jia jiaqs@tsinghua.edu.cn.

6.3 Postdoc position in Reinforcement Learning for Cyber Physical Systems at CFINS, Tsinghua University

The center for intelligent and networked systems (CFINS) at Tsinghua University (Beijing, China) (http://www.cfins.au.tsinghua.edu.cn) invites applications for 1 postdoc position in the field of reinforcement learning for cyber physical systems such as energy Internet and smart buildings. Potential applicants with knowledge on Markov decision process, power systems, robotic systems, and/or building systems are especially encouraged to apply. The potential applicant should be expected to receive a PhD degree in EE/CS/IE/SE or related areas by fall of 2020. This postdoc position is for two years and will be supervised by Professor (Samuel) Qing-Shan Jia. Applications will be reviewed immediately. Interested applicants, please send an email to (Samuel) Qing-Shan Jia jiaqs@tsinghua.edu.cn.

7. International Graduate School on Control

7.1 Introduction to Discrete Event Systems

Instructors: Stephane Lafortune, Christos Cassandras

Marseille, France, June 8-12, 2020

Registration:
http://www.eeci-igsc.eu/

Course summary:
Discrete event systems are dynamic systems with discrete state spaces and event-driven dynamics. They arise when modeling the high-level behavior of cyber-physical systems or when modeling computing and software systems. Discrete event models can be purely logical, or they may include timing and stochastic information. This course will have two parts.
In the first half, we will study logical discrete event systems, focusing primarily on automata models. We will consider estimation, diagnosability, and opacity analysis for partially-observed systems, then supervisory control under full and partial observation. In the second half, we will study the performance analysis, control, and optimization of timed DES, using stochastic timed automata models. We will describe the use of discrete event simulation and review elementary queueing theory and Markov Decision Processes used to study stochastic timed DES. We with then present Perturbation Analysis (PA) theory as a method to control and optimize common performance metrics for DES. Finally, we will explain how to extend DES into Hybrid Systems, limiting ourselves to basic modeling and simple extensions of PA theory.
No prior knowledge of discrete event systems will be assumed. The course will rely on the textbook co- authored by the instructors.

Course outline:

0. Overview of DES and contrast to time-driven systems
1. Introduction to discrete event modeling formalisms
2. Analysis of logical discrete event systems
3. Supervisory control under full and partial observation
4. Timed Models of DES
5. DES (Monte Carlo) computer simulation
6. Review of queueing theory and Markov Decision Processes
7. Perturbation Analysis and Rapid Learning methods
8. From DES to Hybrid Systems